

## **Decision Rationale**

### **Total Maximum Daily Load for Fecal Coliform for Cooks Creek**

#### **I. Introduction**

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by a state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS), that may be discharged to a water quality-limited water body.

This document will set forth the Environmental Protection Agency's (EPA) rationale for approving the TMDL for fecal coliform for Cooks Creek. EPA's rationale is based on the determination that the TMDL meets the following eight regulatory conditions pursuant to 40 CFR §130.

- 1) The TMDL is designed to implement applicable water quality standards.
- 2) The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.
- 3) The TMDL considers the impacts of background pollutant contributions.
- 4) The TMDL considers critical environmental conditions.
- 5) The TMDL considers seasonal environmental variations.
- 6) The TMDL includes a margin of safety.
- 7) There is reasonable assurance that the TMDL can be met.
- 8) The TMDL has been subject to public participation.

#### **II. Background**

The Cooks Creek watershed is located in Rockingham County. The watershed is 28,174 acres in size, including the Blacks Run subwatershed. Blacks Run is a major tributary for Cooks Creek, a separate fecal coliform TMDL was developed for Blacks Run. The TMDL addresses a 13.32 mile segment of Cooks Creek, beginning at its headwaters and terminating at its confluence with North River. Developed (82%) and agricultural (9%) lands make up 91% of the 12,255 acre Blacks Run watershed. Developed (43%) and agricultural (49%) lands make up 92% of the 28,174 acre Cooks Creek watershed. When the Blacks Run subwatershed is removed, the Cooks Creek watershed land use breakdown becomes 26% developed and 67% agricultural.

In response to Section 303(d) of the CWA, the Virginia Department of Environmental

Quality (VADEQ) listed a 13.32 miles of Cooks Creek on Virginia's 1998 Section 303(d) list as being impaired by elevated levels of fecal coliform. Cooks Creek was also listed as impaired for failing to attain the general standard for aquatic life use. The failure to attain the general standard for aquatic life use was determined through biological assessments of the benthic macroinvertebrate community. The impairment to the benthic community was addressed under a separate TMDL and approved by EPA under a different decision rationale. Blacks Run was listed on the 1998 Section 303(d) list for its failure to attain the general standard aquatic life use and elevated levels of fecal coliform. Both of these impairments were addressed under a separate TMDL and subsequently approved by EPA under a different decision rationale.

Fecal coliform is a bacterium which can be found within the intestinal tract of all warm blooded animals. Therefore, fecal coliform can be found in the fecal wastes of all warm blooded animals. Fecal coliform in itself is not a pathogenic organism. However, fecal coliform indicates the presence of fecal wastes and the potential for the existence of other pathogenic bacteria. The higher concentrations of fecal coliform indicate the elevated likelihood of increased pathogenic organisms.

EPA has been encouraging the states to use e-coli and enterococci as the indicator species instead of fecal coliform. A better correlation has been drawn between the concentrations of e-coli and enterococci, and the incidence of gastrointestinal illness. The Commonwealth plans on adopting the e-coli and enterococci standards in late 2002.

As Virginia designates all of its waters for primary contact, all waters must meet the current fecal coliform standard for primary contact. Virginia's standard applies to all streams designated as primary contact for all flows. Through the development of this and other similar TMDLs, it was discovered that natural conditions (wildlife contributions to the streams) could cause or contribute to violations of the fecal coliform standard. Thus, many of Virginia's TMDLs have called for some reduction in the amount of wildlife contributions to the affected streams. EPA believes that a significant reduction in wildlife is not practical and will not be necessary due to the implementation plan discussed below.

A phased implementation plan will be developed for all streams in which the TMDL calls for reductions in wildlife. In Phase 1 of the implementation, the Commonwealth will begin implementing the reductions (other than wildlife) called for in the TMDL. In Phase 2, which can occur concurrently to Phase 1, the Commonwealth will consider addressing its standards to accommodate this natural loading condition. The Commonwealth has indicated that during Phase 2, it may develop a Use Attainability Analysis (UAA) for streams with wildlife reductions which are not used for frequent bathing. Depending upon the result of the UAA, it is possible that these streams could be designated for secondary contact. The Commonwealth will also investigate incorporating a natural background condition for the bacteriological indicator.

After the completion of Phase 1 of the implementation plan, the Commonwealth will monitor the stream to determine if the wildlife reductions are actually necessary, as the violation level associated with the wildlife loading may be smaller than the percent error of the model or the MOS. In Phase 3, the Commonwealth will investigate the sampling data to determine if further

load reductions are needed in order for these waters to attain standards. If the load reductions and/or the new application of standards allow the stream to attain standards, then no additional work is warranted. However, if standards are still not being attained after the implementation of Phases 1 and 2, further work and reductions will be warranted.

Cooks Creek identified as watershed VAV-B25R, was given a high priority for TMDL development. Section 303(d) of the CWA and its implementing regulations require a TMDL to be developed for those waterbodies identified as impaired by the state where technology-based and other controls do not provide for the attainment of water quality standards. The TMDL submitted by Virginia is designed to determine the acceptable load of fecal coliform which can be delivered to Cooks Creek, as demonstrated by the Better Assessment Science Integrating Point and Nonpoint Sources (BASINS), in order to ensure that the water quality standard is attained and maintained. BASINS is considered an appropriate model to analyze this watershed because of its dynamic ability to simulate both watershed loading and receiving water quality over a wide range of conditions.

The TMDL analysis allocates the application/deposition of fecal coliform to land based and instream sources. For land based sources, BASINS utilizes the Nonpoint Source Model (NPSM) to account for the buildup and washoff of pollutants from these areas. Buildup (accumulation) refers to all of the complex spectrum of dry-weather processes that deposit or remove (die-off) pollutants between storms.<sup>1</sup> Washoff is the removal of fecal coliform which occurs as a result of runoff associated with storm events. These two processes allow the model to determine the amount of fecal coliform from land based sources which is reaching the stream. Point sources and wastes deposited directly to the stream were treated as direct deposits. These wastes do not need a transport mechanism to allow them to reach the stream. The allocation plan calls for the reduction in fecal coliform wastes delivered by all sources and land uses (except forests) within the watershed.

Table 1 - Summarizes the Specific Elements of the TMDL.

Segment	Parameter	TMDL	WLA (cfu/yr)	LA (cfu/yr)	MOS (cfu/yr)
Total	Fecal Coliform	5.48E+13	0	4.98E+13	4.98E+12

<sup>1</sup> Virginia includes an explicit MOS by identifying the TMDL target as achieving the total fecal coliform water quality concentration of 190 cfu/100ml as opposed to the WQS of 200 cfu/ml. This can be viewed explicitly as a 5% MOS.

The United States Fish and Wildlife Service has been provided with copy of this TMDL.

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<sup>1</sup>CH2MHILL, 2000. Fecal Coliform TMDL Development for Cedar, Hall, Byers, and Hutton Creeks Virginia,

### III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the eight basic requirements for establishing a fecal coliform TMDL for Cooks Creek. EPA is therefore approving this TMDL. Our approval is outlined according to the regulatory requirements listed below.

*1) The TMDL is designed to meet the applicable water quality standards.*

Virginia has indicated that excessive levels of fecal coliform due to nonpoint sources (both wet weather and directly deposited nonpoint sources) have caused violations of the water quality standards and designated uses on Cooks Creek. The water quality criterion for fecal coliform is a geometric mean 200 colony forming units (cfu)/100mL or an instantaneous standard of no more than 1,000 cfu/100ml. Two or more samples over a 30 day period are required for the geometric mean standard. Since the state rarely collects more than one sample over a thirty-day period, most of the samples are measured against the instantaneous standard. Ambient water quality monitoring (AWQM) data has been collected monthly from Cooks Creek since 1991. Ninety percent of the 97 fecal coliform samples collected from the AWQM station located on Cooks Creek since December 1991, have violated the instantaneous standard. The mean and median of the sample set are 7,361 cfu/100mL and 6,400 cfu/100mL respectively.

The BASINS and NPSM models are being used to determine the fecal coliform deposition rates to the land as well as loadings to the stream from point and other direct deposit sources necessary to support the fecal coliform water quality criterion and primary contact use. The following discussion is intended to describe how controls on the loading of fecal coliform to Cooks Creek will ensure that the criterion is attained.

The TMDL modelers determined the fecal coliform production rates within the watershed. Data used in the model was obtained on a wide array of items, including farm practices in the area, the amount and concentration of farm animals, point sources in the watershed, animal access to the stream, wildlife in the watershed, wildlife fecal production rates, land uses, weather, stream geometry, etc.. The data was combined by the model to determine the hydrology and water quality of the stream.

Calibration is the process of comparing modeled data to observed data and making appropriate adjustments to model parameters to minimize the error between observed and simulated events.<sup>2</sup> A “paired watershed” approach was used for the hydrology calibration for Cooks Creek. A “paired watershed” or “equivalent watershed” approach was used because there was insufficient hydrology data on Cooks Creek. In a “paired watershed” approach, the modelers model the hydrology of a stream with an adequate hydrologic record (Blacks Run) that would have a response similar to the watershed being studied (Cooks Creek).

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<sup>2</sup>Maptech, 2002. Fecal Coliform TMDL Development for Catoctin Creek Impairments, Virginia. April 23, 2002.

Blacks Run is the major tributary to Cooks Creek and has a more urbanized watershed. Many of the urban areas within Blacks Run contain vast green spaces and the lower watershed is more agricultural. United States Geological Survey (USGS) had a continuous gage monitoring flow on Blacks Run from 1999 through 2001. This gage was installed for the development of a fecal coliform TMDL on Blacks Run. The calibration was run from February 1999 through November 2001. Weather data for the model was obtained from a weather station located in nearby Dale Enterprise. Several parameters including the evapotranspiration rate, recession rates to groundwater and interflow, storage capacity within the subsurface and surface zones, slope, and forest cover were evaluated and/or adjusted to insure that the calibration closely represented the observed data. The statistical flow checks indicated that the simulation matched the observed flow data on Blacks Run within the accepted bounds.

A validation run is usually conducted to see how well the model simulates a different set of observed data. Due to the limited amount of flow data, the validation run could not be conducted for Blacks Run.

The model was then transferred to Cooks Creek for use in the hydrology and water quality modeling. The water quality calibration was from February 1999 to November 2001. During the water quality calibration, hourly simulated data was evaluated against the sporadic grab samples.

EPA believes that using BASINS and NPSM to model and allocate the fecal coliform loadings will ensure that the designated uses and water quality standards will be attained and maintained for Cooks Creek.

*2) The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.*

#### Total Allowable Loads

Virginia indicates that the total allowable loading of fecal coliform is the sum of the loads allocated to land based precipitation driven nonpoint source areas (forest, developed and agricultural land segments), directly deposited nonpoint sources of fecal coliform (cattle in-stream, wildlife in-stream, and straight pipes), and point sources. Activities such as the application of manure and the direct deposition of wastes from grazing animals are considered fluxes to the land use categories. The actual value for the total fecal load can be found in Table 1 of this document. The total allowable load is calculated on an annual basis due to the nature of the models.

#### Waste Load Allocations

Virginia has stated that there are four point source discharging within the Cooks Creek watershed. Two of the facilities discharge directly to Cooks Creek with the remaining discharging to Blacks Run. Two of these facilities are permitted to discharge fecal coliform. These facilities

are located on Blacks Creek and are permitted to discharge fecal coliform at a concentration of 200 cfu/100 mL. Each facility has a design flow of 1,000 gallons per day. These facilities were not given a specific wasteload allocation (WLA) under this TMDL but were provided with a WLA in the Blacks Run TMDL. The TMDL model for Cooks Creek treated the loading from Blacks Run as a point source and did not reduce or alter any of its loadings. The WLAs for these facilities, U.S. Training and Development Center and a single family treatment system, can be found in the Blacks Run TMDL. The WLAs were determined by multiplying the facility's permitted fecal coliform concentration (200 cfu/100 mL) by their permitted flow by the number of days in a year (365). The WLA for each of these facilities was  $2.76E+9$ .

EPA regulations require that an approvable TMDL include individual WLAs for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR 130.7." Furthermore, EPA has authority to object to the issuance of any National Pollutant Discharge Elimination System (NPDES) permit that is inconsistent with the WLAs established for that point source.

#### Load Allocations

According to Federal regulations at 40 CFR 130.2(g), load allocations (LAs) are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible, natural and nonpoint source loads should be distinguished.

In order to accurately simulate landscape processes and nonpoint source loadings, VADEQ used the BASINS and NPSM models to represent the Cooks Creek watershed. These models provide a comprehensive modeling system for the simulation of watershed hydrology, point and nonpoint loadings, and receiving water quality for conventional pollutants. The models use precipitation and weather data to determine flow and loadings. The total land loading of fecal coliform is the result of the application of manure and direct deposition from cattle, other livestock and wildlife (geese, deer, etc.), the deposition of fecal coliform from failed septic systems, and fecal coliform production from pets.

In addition, VADEQ recognizes the significance of fecal coliform from directly deposited sources such as cattle in-stream and wildlife in-stream. These sources are not dependent on a transport mechanism to reach a surface waterbody, and therefore, can impact water quality during low and high flow events. Significant reductions from all sources were required to meet the geometric mean standard. Although the amount of fecal coliform bacteria that is produced by wildlife is far less than the loads that are produced by livestock in the watershed, reductions in these sources were also required due to their impacts during low flow events. The TMDL was modeled with interflow (shallow subsurface flow) containing a fecal coliform concentration of 1,500 cfu/ 100 mL. This assumption although backed by data was different than the assumption used by the Commonwealth in other TMDLs. Reductions seen in interflow can be obtained through load reductions for land applied loads.

Table 3 - LA for the Land Application of Fecal Coliform

Land Use/Source	Existing Load	Allocated Load	Percent Reduction
Built-Up	1.24E+14	1.10E+12	99%
Cropland	1.54E+15	1.55E+13	99%
Forest	2.15E+12	4.27E+10*	0%
Pasture	2.92E+15	2.92E+13	99%
Cattle In-Stream	1.53E+14	0	100%
In-Stream Septics	8.86E+13	0	100%
Wildlife In-Stream	1.31E+14	3.92E+12	97%

\*Reductions to subsurface flows only.

*3) The TMDL considers the impacts of background pollution.*

A background concentration was set by determining the wildlife loading to each land segment.

*4) The TMDL considers critical environmental conditions.*

According to the EPA regulation 40 CFR 130.7 (c)(1), TMDLs are required to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of Cooks Creek is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards<sup>3</sup>. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable “worst-case” scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum. These critical conditions ensure that water quality standards will be met for other than worst case scenarios.

The sources of bacteria for these stream segments were a mixture of dry and wet weather

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<sup>3</sup>EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

driven sources. Therefore, the critical condition for Cooks Creek was represented as a typical hydrologic year. Since the stream was modeled to attain the geometric mean standard and base and low flow events occurred far more often than wet weather events, it was essential that the standard be maintained during these periods.

*5) The TMDLs consider seasonal environmental variations.*

Seasonal variations involve changes in stream flow as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flows normally occur in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods. Consistent with our discussion regarding critical conditions, the model and TMDL analysis effectively considered seasonal environmental variations. The model also accounted for the seasonal variation in loading. Fecal coliform loads changed for many of the sources depending on the time of the year. For example, cattle spent more time in the stream in the summer and animals were confined for longer periods of time in the winter.

*6) The TMDLs include a margin of safety.*

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. The MOS may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or TMDL. Virginia includes an explicit MOS by establishing the TMDL target water quality concentration for fecal coliform at 190 cfu/ 100mL, which is more stringent than Virginia's water quality standard of 200 cfu/100 mL. This would be considered an explicit 5% MOS.

*7) There is a reasonable assurance that the TMDL can be met.*

EPA requires that there be a reasonable assurance that the TMDL can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program. Additionally, Virginia's Unified Watershed Assessment, an element of the Clean Water Action Plan, could provide assistance in implementing this TMDL.

The TMDLs in their current form are designed to meet the applicable water quality standards. However, the reductions needed to attain these standards are extreme. The Commonwealth intends to implement these TMDLs through best management practices (BMPs). The implementation of these practices will occur in stages. This will allow the Commonwealth to monitor the benefits of the BMPs and determine which practices have the greatest impacts on



water quality. It will also provide a mechanism for developing public support and checking the accuracy of the model.

The TMDL in its current form is designed to meet the applicable water quality standards. However, due to the wildlife issue that was previously mentioned, the Commonwealth believes that it may be appropriate to modify its current standards to address the problems associated with wildlife loadings.

*8) The TMDLs have been subject to public participation.*

Two public meetings were held to discuss TMDL development on Blacks Run and Cooks Creek. Both of these meetings were public noticed in the *Virginia Register* and opened to a 30 day comment period. The first meeting was held on April 12, 2001 in Dayton, VA. Eleven people attended this initial meeting on the TMDL. Fourteen people attended the second meeting which was held at VADEQ's Regional Office in Harrisonburg, VA on March 28, 2002.